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[continued on next page]

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Patent Application

of

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and

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PISTON-TYPE ACCUMULATOR

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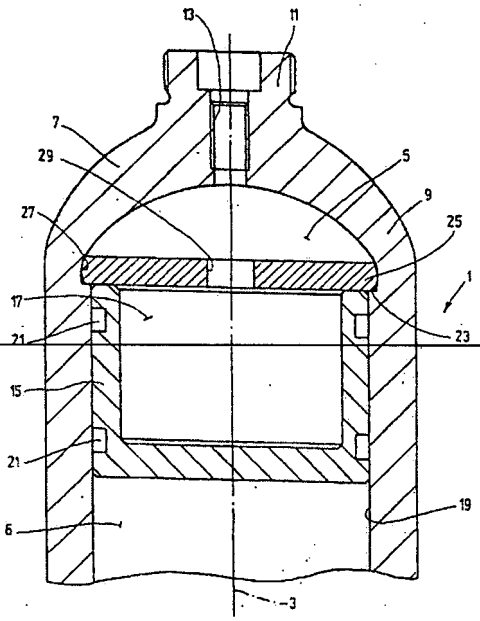

(57) **Abstract:** The invention relates to a piston-type accumulator comprising an accumulator housing provided in the form of a cylinder tube (1), inside of which a separating piston (15), which separates two working spaces (5) and (6) from one another, can be displaced in an axial direction within a piston stroke area (19) of the cylinder tube (1), which is closed at both axial ends by a closure part (7) of which at least one, by deforming a deforming area (9) of the wall of the cylinder tube (1), said deforming area adjoining the piston stroke area (19), is provided in the form of part that exists as a single piece therewith. A stop body (25), which limits the movement of the separating piston (15) before reaching the deforming area (9), is provided inside the cylinder tube (1) at the location where the piston stroke area (19) transitions into the deforming area (9).

(57) **Zusammenfassung:** Bei einem Kolbenspeicher mit einem Speichergehäuse in Form eines Zylinderrohres 1, in dem ein Trennkolben 15, der zwei Arbeitsräume 5 und 6 voneinander trennt, in Axialrichtung innerhalb eines Kolbenhubbereiches 19 des Zylinderrohres 1 verfahrbar ist, das an beiden axialen Enden durch einen Verschlussteil 7 abgeschlossen ist, von denen zumindest einer durch Verformen eines sich an den Kolbenhubbereich 19 anschliessenden Umformbereiches 9 der Wand des Zylinderrohres 1 als damit einstöckiger Teil ausgebildet ist, ist im Inneren des Zylinderrohres 1 an der Stelle des Übergangs vom Kolbenhubbereich 19 zum Umformbereich 9 ein die Bewegung des Trennkolbens 15 vor Erreichen des Umformbereiches 9 begrenzender Anschlagkörper 25 vorgesehen.

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Reference is made for an explanation Field of the *two-letter codes and the other abbreviations to the Guidance Notes on Codes and Abbreviations in the front section of each regular PCT Gazette edition.* Invention

~~Piston-Type Accumulator~~

The present invention relates to a piston-type accumulator having an accumulator housing in the form of a cylindrical tube ~~in which a~~. A separating piston~~, which~~ separates two working chambers from each other~~,~~ in the housing, and may be moved in the axial direction within a piston stroke area of the cylindrical tube ~~which~~. The cylindrical tube is closed off at both axial ends by ~~a closing component, at least one of which~~ closing components. At least one closing component is configured by shaping of a reshaping area of the wall of the cylindrical tube adjoining the piston stroke area as an integral part of such wall.

Background of the Invention

Piston-type accumulators, in the broadest sense of the term, are ~~in the~~ a category of ~~so-called~~ hydraulic accumulators~~,~~ which perform the function of receiving specific volumes of a pressurized liquid (hydraulic medium) from a hydraulic system and returning these volumes to the system as required. Since the hydraulic medium is under pressure, hydraulic accumulators are treated as pressurized containers and must be designed for the maximum excess operating pressure~~, with allowance~~. Allowance must be made for the acceptance standards of diverse countries in which the containers are installed. In most hydraulic systems, use is currently made of hydropneumatic (gas-impinged) accumulators with separating elements~~, a~~. A piston ~~which~~ separates a fluid space as a working chamber from a gas supply space as another working chamber, thereby serving as the separating element inside the accumulator housing of the piston-

type accumulator. As a rule, nitrogen is used as the operating gas ~~and the~~. The gas-tight piston to a great extent permits decoupling of gas supply space from liquid space.

The fluid component is connected to the hydraulic ~~circulation~~circuit, so that the piston-type accumulator receives fluid when the pressure rises and the gas is compressed in the process. The compressed gas expands as the pressure drops, and forces the stored pressurized fluid back into the hydraulic ~~circulation.~~circuit. It is an advantage of piston-type accumulators that they can ~~A~~"work@" in any position, but preference is to be given to a vertical arrangement with the gas side on top so that settling of fouling particles from the fluid onto the piston seals is prevented.

The essential components of a piston-type accumulator thus are an outer cylindrical tube ~~as~~ forming an accumulator housing, ~~the~~ a piston with a sealing system as a separating element, and closing components on the front side which are both cover elements and at the same time also include a fluid connection and a gas connection. The accumulator is as a rule assigned two functions, that of supplying the interior pressure and that of ensuring control of the piston inside the accumulator housing.

In an effort to make production of hydraulic accumulators more efficient and cost-effective, a transition has already been made to not providing a separate cover part as the closing component fastened at least on the front end side of the cylindrical tube ~~but rather to configuring.~~ Rather, the closing component is configured as an integral part with the front end of the cylindrical tube~~, the~~. The wall of this tube ~~being~~ is shaped in a reshaping area. WO 98/55258 discloses an appropriate example of the production of a hydraulic accumulator in the form of a diaphragm accumulator. Shaping of the closing component is effected by conventional means as a function of the type of material of the cylindrical tube by cold or hot working, for example, after flame or induction heating has been completed, by ~~means of~~ rolling or compressing~~, the~~.

The end of the cylindrical tube ~~being~~ is reshaped to a bottom with a collar turned outward on which a connection for the appropriate operating medium is formed. While the expenditure of production effort required for production of a diaphragm accumulator is simplified, problems arise if such processes are to be carried out for production of piston-type accumulators.

~~On the basis of this state of the art the~~Summary of the Invention

An object of the present invention is to ~~create~~provide a piston-type accumulator ~~the~~ having a construction ~~of which affords the possibility of~~affording simple and efficient production of the accumulator housing by shaping of the cylindrical tube on the end without generating problems during operation with respect to the behavior of a piston-type accumulator manufactured in this manner.

~~It is claimed for the invention that this~~ This object is attained in the case of a piston-type accumulator ~~as indicated in the foregoing in that~~where there is provided in the interior of the cylindrical tube, at the point of transition from the piston stroke area to the reshaping area, a stop element restricting the movement of the separating piston before reaching the reshaping area.

As a result of the restriction or blocking of the piston movement ~~with~~, the piston in ~~an~~its end position ~~in which the piston~~ is still outside the reshaping area~~, as claimed for the invention~~. Thus, the risk of interruption of operation is effectively prevented. If there were no piston end position specified for piston-type accumulators with a reshaping area provided on the end of the cylindrical tube, ~~so that~~ the separating piston could enter the reshaping area in certain operating situations, such as loss of gas in the gas supply space or high fluid pressures for example~~, the~~. The danger would then exist of canting or seizing of the piston because of the possible change in the geometry of the piston ~~during~~ due to shaping of the wall of the cylindrical tube and

roughened areas in the interior of the end of the housing due to the reshaping. The stop element mounted inside the cylindrical tube in such a position ~~as claimed for the~~according to the present invention, in which the end position of the reshaping area is secured at the end of the piston thrust area and accordingly before entry into the reshaping area, makes certain that the trouble-free and gas-tight control of the piston afforded by the interior wall of the cylindrical tube in the piston stroke area will be maintained under all piston operating conditions.

~~By preference~~ Preferably, the stop element is positively fitted so as to be secured from axial movement by retaining surfaces positioned on the inside of the wall of the cylindrical tube~~, so that definite~~. Definite limitation of the stroke of the piston is then ensured even in the event of hard contact with the stop element.

A first retaining surface positioned at the end of the piston stroke area may be configured as a shoulder, forming a recess in the inner wall of the cylindrical tube. The stop element may be introduced into the cylindrical tube from the adjacent open end and positioned on the shoulder before shaping during production of the piston-type accumulator. The stop element is now mounted in a specific position for the shaping step forming the closing component of the cylindrical tube. A second retaining surface positively locking the stop element, a surface positioned inside the reshaping area, may now be configured by shaping the wall of the cylindrical tube forming the closing component~~, the~~. The wall of the cylindrical tube ~~being~~is shaped during shaping around the wall area of the stop element situated in the reshaping area.

This "molding" of the stop element is found to be especially advantageous if the stop element is in the form of a level plate having on its circumference a crowned, convex camber around which the wall of the cylindrical tube is shaped during formation of the closing component in order to configure the second retaining surface situated in the reshaping area.

When use is made of a stop element in the form of a plate, that is, a rigid structural element situated in the cylindrical tube at the point of transition to the reshaping area, the additional advantage is gained that the stop element functions as a support element in the process of shaping~~, so that the~~. The piston stroke area situated in advance of the circumferential area is then supported during configuration of the closing component, and accordingly is protected from any alteration of its geometry potentially caused by the shaping process.

~~Use of a~~ The plate-shaped stop element may be replaced by an annular element round in cross-section, such as a steel ring which is forced into a seat forming the positive-locking retaining surface~~, this~~. This seat ~~being~~ is installed in the inner wall of the cylindrical tube.

~~The invention will be described below with reference to the exemplary embodiments illustrated in the drawing, in which~~

~~FIG. 1 presents a simplified diagram of a detached longitudinal section of an exemplary embodiment of the piston-type accumulator claimed for the invention, of which~~ Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses preferred embodiments of the present invention.

Brief Description of the Drawings

Referring to the drawings which form a part of this disclosure:

FIG. 1 is a partial, simplified, diagrammatic side elevational view in section of a piston accumulator according to a first embodiment of the present invention, with only the end area of the accumulator housing on the gas side ~~is~~ being shown, and the piston sealing and control means being omitted~~,~~; and

FIG. 2 ~~a longitudinal~~ is a partial, simplified, diagrammatic side elevational view in section, similar to ~~that of~~ FIG. 1, of a piston accumulator according a second ~~exemplary~~ embodiment of the present invention.

Detailed Description of the Invention

In the case of the piston-type accumulators ~~claimed for the~~ according to the present invention and shown in the ~~drawing~~drawings, the accumulator housing has a round cylindrical tube 1 which defines a longitudinal axis 3. In its end area, the cylindrical tube 1 has on ~~the~~its gas side a closing component 7 delimiting a gas supply space 5~~, which~~. Closing component~~,~~ 7 is formed as an integral part or unitary, one-piece of the cylindrical tube 1, and is formed by shaping the wall of the cylindrical tube 1 in a reshaping area 9. As has already been stated, the shaping process forming the closing component 7 ~~has been~~ is carried out in accordance with a reshaping process disclosed in the prior art~~, a~~. A cold or hot working process ~~being~~ is executed by ~~means of~~ rolling or chasing tools or the like, as a function of the properties of the metal material making up the cylindrical tube 1~~, in order to configure the~~. The closing component 7 is configured as a closed bottom on which a neck component 11 is formed projecting coaxially to the axis 3~~a~~. The neck component ~~11 on which are configured~~ has a gas channel 13 leading to the gas supply space 5 and a connection for appropriate connection fittings (not shown).

A separating piston 15 ~~which~~ forms the separating element between gas supply space 5 and a fluid space 6, has a trough-like recess 17 concentric with the longitudinal axis for

increasing the volume of the gas supply space 5, and is controlled inside a piston stroke area 19 of the cylindrical tube 1 so as to be longitudinally displaceable. The inside of the wall of the cylindrical tube is microfinished in the piston stroke area 19 ~~in order~~ to ensure gas-tight and low-friction piston control inside the piston stroke area 19 in conjunction with piston closing and piston control means provided on the circumference of the piston 15. The sealing and control means provided on the circumference of the piston 15 are not shown in the drawing. These means, seated in circumferential annular grooves 21 of the piston 15, may be of conventional design.

At the end of the piston stroke area 19 ~~there is in~~, the inner wall of the cylindrical tube 1 has a shoulder 23 forming a recess in the inner wall. This shoulder makes available a level stop surface for a level plate 25 ~~for~~. For the fixing of ~~which~~ the plate in position ~~it~~, the level stop surface forms a retaining surface which locks the plate 25 positively against axial movement in the direction of the piston stroke area 19. The plate 25 has a convex, crowned circumferential surface 27. During shaping of the wall of the cylindrical tube 1, in which the reshaping area 9 adjoining the piston stroke area 19 is formed, the wall of the cylindrical tube 1 is shaped around the crowned circumferential surface 27 of the plate 25 ~~, so that the~~ . The shaped cylinder wall then forms a second retaining surface on the crowned circumferential surface 27 for fixing the plate 25 in position so that the ~~latter~~ plate is secured positively against axial movement in both directions.

In the process of production of the hydraulic accumulator, the plate 25 is introduced from the initially open end of the cylindrical tube and positioned against the shoulder 23 so that it accordingly is suitably positioned for the shaping step. As additional fixing in position, in advance of execution of the shaping step forming the reshaping area 9, the recess 23 forming the shoulder 23 in the inner wall of the cylindrical tube 1 may be configured so that the bottom of

the recess forms in conjunction with the crowned circumferential surface 27 of the plate 25 a press fit which holds the plate 25 in position during shaping of the circumferential area 9.

An opening 29 configured centrally in the plate is provided as gas discharge opening. The plate 25, designed as a relatively rigid structural element of a steel material, for example, forms not only a stop element for the piston 15 which blocks movement of this piston before leaving the piston stroke area 19, but additionally forms a rigid support element for the cylindrical tube 1 in the area of transition from the piston stroke area 19 to the reshaping area 9 during the shaping process~~, in such a way that the~~. The shaping forces acting on the reshaping area 9 then can cause no changes in the geometry of the cylindrical tube 1 in the piston stroke area 19. The piston 15 is accordingly controlled in the microfinished piston stroke area 19 under all operating conditions of the piston-type accumulator~~, the~~. The plate 25 ~~acting~~acts as stop element making certain that no introduction of the piston 15 into the reshaping area 9 may occur~~, while the~~. The inner wall of the cylindrical tube 1, unlike piston stroke area 19 extending to the shoulder 23, requires no microfinishing on the inside.

The exemplary embodiment shown in FIG. 2 differs from the example shown in FIG. 1 only to the extent that the stop element limiting piston movement at the end of the piston stroke area 19 of the cylindrical tube 1 is a steel ring 31, rather than a plate. In this exemplary embodiment the shoulder 23 on the inside of the cylindrical tube 1 forms at the end of the piston stroke area 19~~ a~~. A cambered partial surface of a cambered inner annular groove 33 ~~which~~ forms the seat for the steel ring 31. The cambered surface of this annular groove 33, which extends around an adequate circumferential area of the steel ring 31, forms the retaining surfaces positively locking the ring 31 from axial movement in both directions.

A closed ring 31 may be used if the annular groove 33 is configured exclusively by the shaping which forms the reshaping area 9 in the area axially some distance from the shoulder 23~~, so that the~~. The steel ring 31 may be introduced from the open end of the cylindrical tube 1 in advance of shaping. As an alternative, that is, if the annular groove is not finished in the shaping process, that is, so to speak ~~A~~"is closed~~, @~~," a slotted steel ring 31 may be forced into an already fully configured annular groove 33.

In the example shown in FIG. 1, a plate 25 with only one opening 29 for gas discharge opening is shown. It is obvious that a plate having several openings, including one in the form of a mesh plate, could be provided.

Claims

1. A piston-type accumulator having an accumulator housing in the form of a cylindrical tube (1) in which a separating piston (15) which separates two working chambers (5 and 6) from each other may be moved in the axial direction within a piston stroke area (19) of the cylindrical tube (1), which is closed off at both axial ends by a closing component (7), at least one of which closing components is configured by shaping of a reshaping area (9) of the wall of the cylindrical tube (1) adjoining the piston stroke area (19) as an integral component of such wall, **characterized in that** there is provided in the interior of the cylindrical tube (1), at the point of transition from the piston stroke area (19) to the reshaping area (9), a stop element (25) restricting the movement of the separating piston (15) before the reshaping area (9) is reached.

2. The piston-type accumulator as claimed in claim 1, wherein the stop element (25) is locked positively against axial movement by retaining surfaces present on the inside of the wall of the cylindrical tube (1).

3. The piston-type accumulator as claimed in claim 2, wherein a first retaining surface positioned at the end of the piston stroke area (19) is formed by a shoulder (23) forming a recess in the inner wall of the cylindrical tube (1).

4. The piston-type accumulator as claimed in claim 3, wherein a second retaining surface positioned inside the reshaping area (9) is formed by the shaping of the wall of the cylindrical tube (1) configuring the closing component (7).

~~5. The piston-type accumulator as claimed in claim 3 or 4, wherein there is provided as stop element a support element in the form of a level plate (25) having at least one opening (29) as discharge opening for the operating medium present in the respective working chamber (5) and wherein the shoulder (23) forming the first retaining surface on the inner wall of the cylindrical tube (1) is a level step surface for installation on the opposite level circumferential edge of the plate (25).~~

~~6. The piston-type accumulator as claimed in claim 5, wherein the plate (25) has on the circumferential surface (29) a crowned, convex camber around which the wall of the cylindrical tube (1) is shaped during formation of the closing component (7), in order to configure the second retaining surface positioned in the reshaping area (9).~~

~~7. The piston-type accumulator as claimed in claim 1 or 2, wherein an annular element (31) round in cross-section is provided as stop element and wherein the shoulder (23) made in the inner wall of the cylindrical tube (1) and forming the first retaining surface forms a cambered partial surface of a seat (33) for the annular element (31).~~

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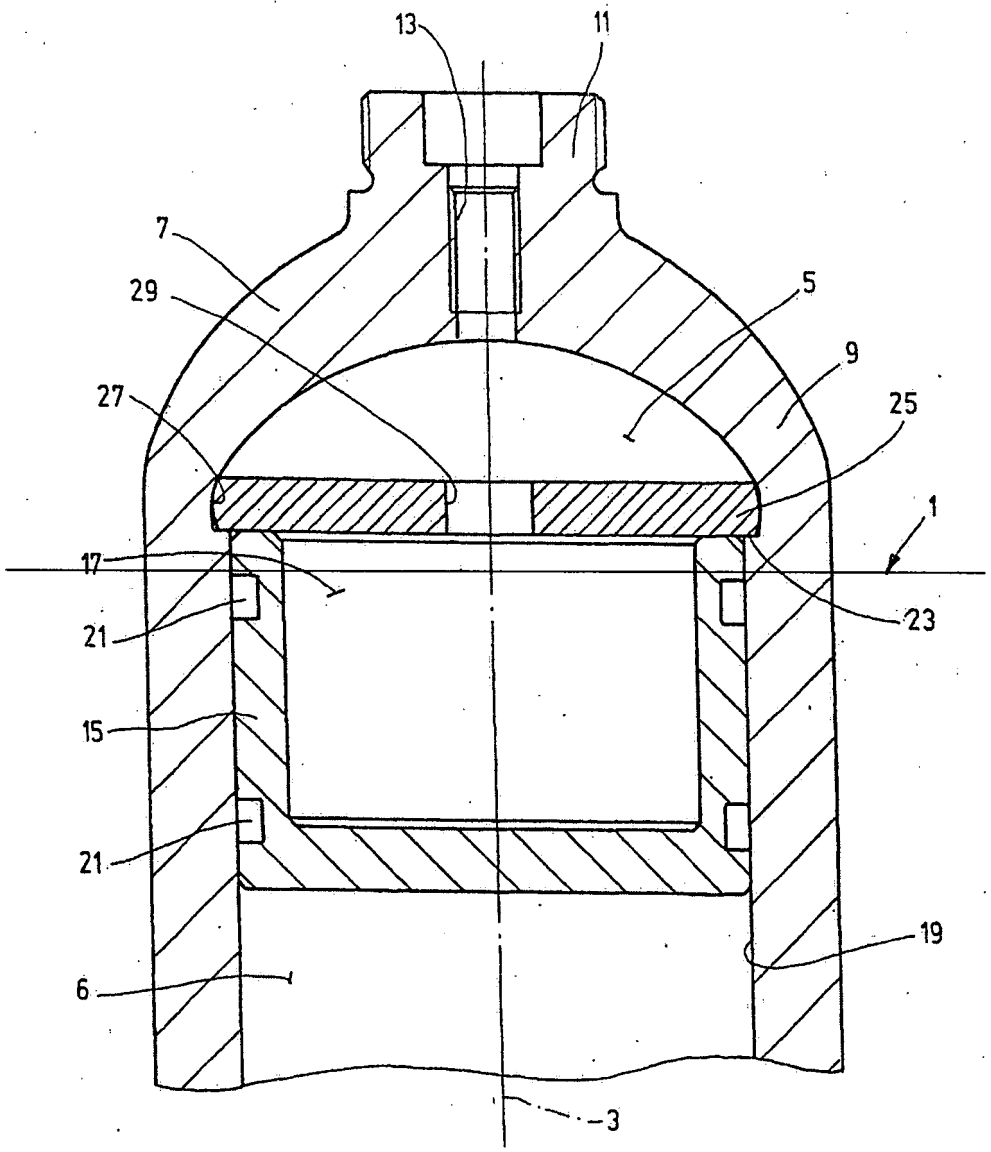

Fig.1

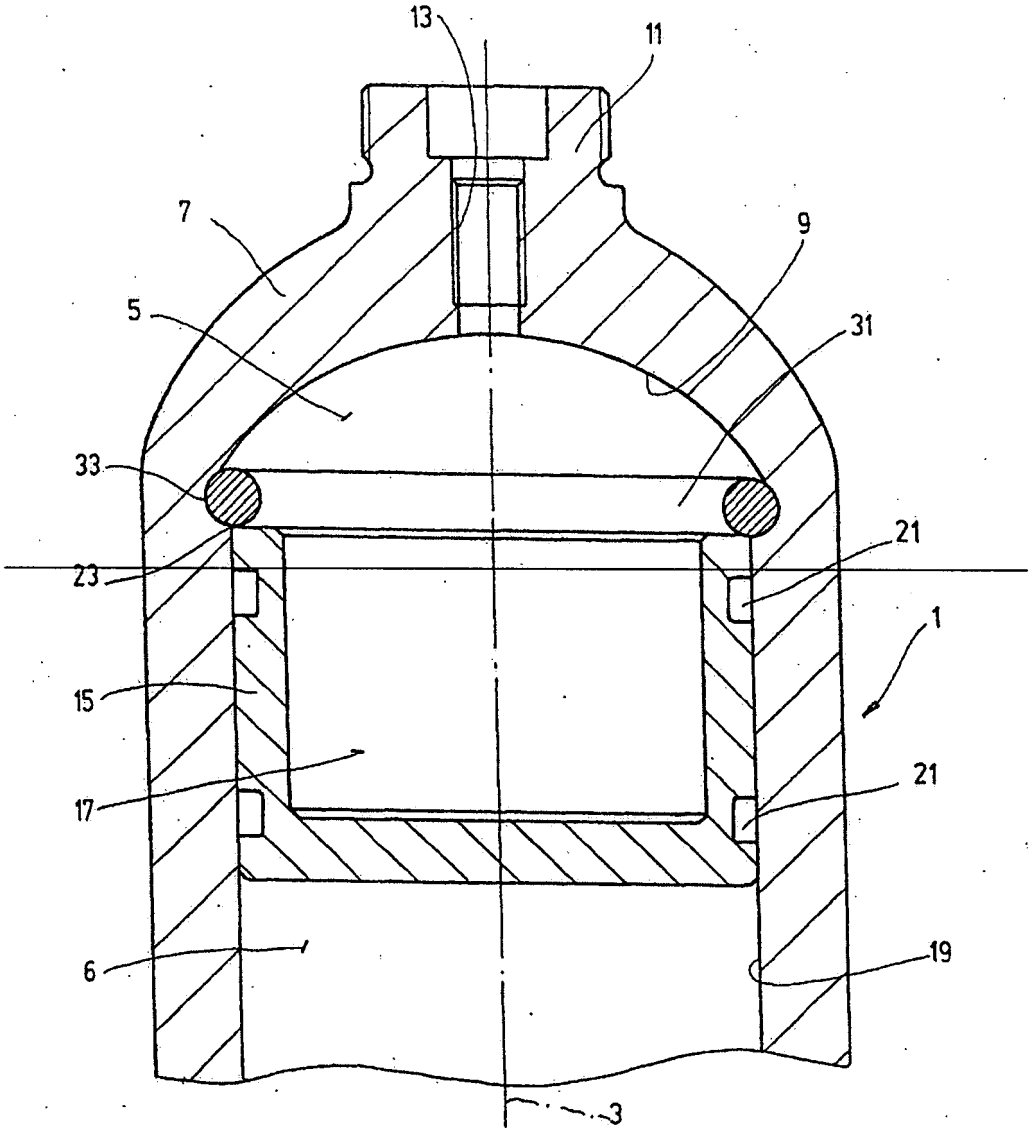

Fig.2

While various embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

PISTON-TYPE ACCUMULATOR

Abstract of the Disclosure

A piston-type accumulator includes an accumulator housing provided in the form of a cylinder tube (1). A separating piston (15) separates two working spaces (5) and (6) from one another in the housing and can be displaced in an axial direction within a piston stroke area (19) of the cylinder tube (1). The cylindrical tube is closed at one axial end by a closure part (7). The closure part is defined by deforming a deforming area (9) of the wall of the cylinder tube (1). The deforming area adjoining the piston stroke area (19) is provided in the form of part that exists as a single piece with the housing. A stop body (25), which limits the movement of the separating piston (15) before reaching the deforming area (9), is provided inside the cylinder tube (1) at the location where the piston stroke area (19) transitions into the deforming area (9).